FOREST PEST MANAGEMENT
Pacific Southwest Region

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AN EVALUATION OF DWARF AND TRUE MISTLETOES IN NORTH SHORE CAMPGROUND, ARROWHEAD RANGER DISTRICT, SAN BERNARDINO NATIONAL FOREST

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ABSTRACT

The North Shore Campground was examined to assess the effects of both dwarf and true mistletoes. Western dwarf mistletoe was present in a few areas and at various intensities on Coulter pine. True mistletoe on California black oak was widely distributed and causing dieback and decline of numerous trees. Considering the current situation and expected future effects of both mistletoes, control treatments at this time would benefit the trees and the campground. Limited Forest Pest Management funds for dwarf mistletoe control are available; guidelines and procedures for suppression projects are included.

INTRODUCTION

The North Shore Campground was inspected on November 2 and 3, 1981, by Forest Pest Management (FPM) pathologist John Pronos and entomologist John Dale. They were accompanied during the first part of the evaluation by District Recreation Officer, Joel Strong.

The objectives of the inspection were to assess the severity of both dwarf and true mistletoes on campground trees, and to determine whether any control measures were warranted and feasible. Other pests observed during the visit were noted. A silvicultural prescription that recognized most existing pest situations had already been prepared for the campground.

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OBSERVATIONS

Overstory vegetative cover consisted of California black oak (6-40" dbh) with scattered pole and sawtimber size Coulter pine. The understory, where present, was predominantly brush; however, a few planted Monterey x knobcone pine saplings were doing well. Scattered dense aggregates of black oak and suppressed Coulter pine were also present. There was no recent tree mortality in the campground, and there were very few stumps present that might suggest the presence of root disease.

Black oak pests

Almost every black oak in the campground had some degree of true mistletoe (*Phoradendron villosum* spp. *villosum*) infection. We did not attempt to rate or map every infected tree, but rather recorded the location of oaks that had branch dieback associated with true mistletoe plants. Thirty-two trees of this type were identified and were distributed throughout the area occupied by sites 1-21 (see map, page 10). Several trees had more than 20 clusters of mistletoe plants in the crown, indicating a substantial stress on the entire tree. One heavily infected oak appeared to be dead. Dieback of individual branches, however, was seen on trees with only a few mistletoe plants. The amount of dieback was not necessarily proportional to the total number of mistletoe plants in the crown.

Heartrot indicators such as conks and decayed branch stubs were present on many of the larger oaks. The specific decay fungi present were not identified.

The black oaks appeared free of any noticeable insect defoliation, and very few twig galls were found. As expected, there was wood borer activity in dead limbs and branches that was attracting the attention of woodpeckers.

Pine pests

Western dwarf mistletoe (*Arceuthobium campylopodum*) was observed on some of the Coulter pines, but it was not widely distributed throughout the campground. The infected pines were rated using the Hawksworth 6-class system, and mapped as shown on page 10. Comments on the severity of infection, probability of spread, and possible control treatments are listed on page 11.

One large Coulter pine near site 4 was noted in the campground prescription and scheduled for removal because of attacks by the western pine beetle (*Dendroctonus brevicomis*). Upon examination only a few beetle attacks were observed, and these occurred around the margin of a mechanical wound. The death of this large patch of cambium and the exfoliation of what remained of the outer bark may be sufficient to call for tree removal, but insects were not the primary causal factor. Activity by other bark beetles was not seen.

Finally, observations with binoculars of several ponderosa pine crowns and examination of old cone remnants in the litter indicated the frequent loss of almost all the cone crop to gray squirrels and insects. The insect

responsible was one of the coneworms, Dioryctria sp. The area is presently unsuitable for cone collection because of continual heavy losses.

BIOLOGY OF PESTS

The North Shore Campground is currently free of any major tree damage, growth loss or mortality caused by insects. The two mistletoes present, however, are affecting the growth, vigor and longevity of a large proportion of the trees. The pest biology descriptions below will provide information useful to understand and deal with these parasites.

Dwarf mistletoes (Arceuthobium spp.)

Dwarf mistletoes are parasitic, flowering plants that can survive only on a living host. They obtain almost all of their water, nutrients, and minerals from this host.

The parasite spreads by means of seeds that are forcibly shot from fruit in the fall. The seed is covered with a sticky substance, and adheres to whatever it contacts. When a seed lands in the crown of a tree, it may adhere to a needle or twig, where it will remain throughout the winter. The following spring it may germinate and penetrate into the twig. For the next two to four years, the mistletoe will grow within the tree and develop a root-like system in the inner bark and outer sapwood. It will then develop aerial shoots that produce seed in another two to four years.

The spread of dwarf mistletoe is limited to the distance traveled by the seed, which from overstory to understory is usually 20 to 60 feet; with the aid of wind, the seed may occasionally be carried as far as 100 feet. A rule of thumb is that dwarf mistletoe can spread a horizontal distance equal to the height of the plant in the infected tree. Because of the various limits to spread and long life cycle, the actual spread rate through an even-aged stand is usually one to two feet per year.

Some dwarf mistletoes parasitize only one species of conifer. Others may occur on three or four closely-related species, but only rarely do they cross-infect from one conifer genus to another. Because of their specificity, the dwarf mistletoe species can be identified by the hosts they infect.

The effect of dwarf mistletoe on different tree species varies and is significantly influenced by tree vigor. For example, the effect of dwarf mistletoe is less on true fir than on pines; its effect on vigorously-growing trees is less than on slow-growing or stagnated ones. Nevertheless, the dwarf mistletoes are the most serious disease agents on conifers in much of the West, causing extensive growth losses and predisposing trees to successful attack by insects and other pathogens.

The western dwarf mistletoe in North Shore campground infects ponderosa, Jeffrey, Coulter and knobcone pines. The Monterey x knobcone pine hybrid may also be susceptible.

True mistletoes (*Phoradendron* spp.)

Like the dwarf mistletoes, the true mistletoes are flowering plants that require a living host. They are generally less demanding of their hosts than the dwarf mistletoes, yet can be serious pests where individual trees are of high value, as in yards, parks, and campgrounds.

Some species of true mistletoe grow on only a single genus of tree; others occur on a wide range of hardwoods. Although they are completely parasitic, they manufacture many of their nutrients by photosynthesis and usually require only water and minerals from their hosts. However, if the green aerial shoots of the mistletoe are removed, the root system of the parasite can utilize the host's nutrients and remain alive within an infected branch for years.

Mistletoe infections are spread mainly by birds - including robins, blue birds, thrushes, and cedar waxwings - that feed on the berries. Birds digest the pulp of the berries and excrete the living seeds, often depositing them onto susceptible trees. A viscous coating and hair-like threads on the outer surface of the seeds attach them firmly to twigs and branches, where they germinate and infect the host tissue.

Young or small trees are seldom infected by leafy mistletoe. In nearly all cases, initial infection occurs on the tallest and oldest trees because birds prefer to perch in their tops. Severe buildup of mistletoe often occurs in an already-infected tree because birds are attracted to and may spend prolonged periods feeding on the mistletoe berries.

Trees heavily infected by mistletoe are weakened, have reduced growth rates, and are sometimes killed. Weakened trees are predisposed to successful attack by insects and often succumb during drought or other periods of stress. Branches heavily-laden with mistletoe often break during storms or high winds, and trunk swellings may provide an entrance point for decay fungi, further increasing the hazard to people and property in campgrounds and other developed sites.

The true mistletoe in North Shore Campground occurs almost exclusively on oaks. Other hosts in California include manzanita, buckeye, and black locust. Mature leaves are somewhat stiff and hairy, and are approximately 0.6-1.8 inches long by 0.4-0.9 inches wide.

DISCUSSION - DWARF MISTLETOE

Is dwarf mistletoe control warranted? The disease is not currently widespread, but if no action is taken it will intensify by spreading to healthy trees and deteriorating trees already infected, making them more susceptible to insect attack. Severely infected trees usually die within 10-15 years unless environmental stresses such as drought or overstocking accelerate this mortality. The eventual impact of the dwarf mistletoe will be to decrease the species mix or to create treeless openings.

The progressive effects of dwarf mistletoe on trees are not dramatic or immmediately obvious to the casual observer but take place over a long period. Control projects, therefore, are investments in the future health of campground trees, and we certainly encourage the District to consider the benefits of treatment. Thorough and aggressive projects can be very successful in reducing mortality and infection levels while increasing tree vigor and longevity.

Control alternatives

Dwarf mistletoe treatments may include one or any combination of the following:

1. Removing infected overstory trees to protect regeneration.
2. Removing witches' brooms to prolong tree life.
3. Removing all infections by pruning to eliminate the parasite.
4. Removing heavily infected trees that cannot be successfully pruned.
5. Thinning to remove infected trees and release residual trees.
6. Creating buffer strips to prevent reentry of dwarf mistletoe.
7. Favoring resistant species (includes planting).
8. Destroying heavily infected stands or aggregations and then regenerating.

Control procedures and guidelines

The first step in a control project for campgrounds is to map the areas of infestation. Then each infected tree must be examined to decide whether to remove the mistletoe or to remove the entire tree. The enclosed Dwarf Mistletoe Survey Data Sheet (page 12) may be used to help determine individual tree treatments and to estimate project costs. In making these decisions and planning a project, personnel should use the guidelines below. High-value trees and special situations may require deviation from these generalizations. However, deviations should be kept to a minimum in order to maintain treatment effectiveness.

1a. Trees with a dwarf mistletoe rating (DMR) of 3 or less - prune off all lower branches, both healthy and diseased, at the bole up to and including the second whorl of branches above the highest visible mistletoe infection. Experience has shown that removing branches only up to the highest infection or even one more whorl almost certainly results in latent infections appearing in 3-5 years.

b. Trees with a DMR of 4, and no mistletoe in the upper 1/3 of crown - prune to remove infections or take tree out, depending on the condition of crown, tree vigor, distribution of mistletoe and importance of tree.

c. Trees with a DMR of 5 or 6 - remove.

2. A tree should have at least 30% live crown after pruning.

3. Whenever possible, avoid removing more than 50% of a tree's live crown.

4. Bole infections - if the stem diameter at the point of infection is less than 6 inches, remove the tree. Bole infections are not serious from the standpoint of spreading mistletoe, but they deform and/or lead to mortality of small trees and failure of large trees.

5. Branches 1 inch or less in diameter with mistletoe plants within 6 inches of the bole are not prunable because the parasite is probably already in the bole. For each 1-inch increase in branch diameter, the minimum safe distance for pruning increases 2 inches. For example, the minimum safe pruning distance from the bole to mistletoe plants for branches 1 to 2 inches in diameter is 8 inches.

6. Removing witches' brooms from high-value trees will increase the vigor and longevity of those trees. It may not be possible or acceptable to remove all remaining branch infections, and this means that a source of mistletoe seed is still in the crown.

7. Some infections may be left in desirable isolated trees where there are no susceptible trees within range of remaining mistletoe shoots/seeds. This is often the case when broom pruning is used.

8. In very dense aggregations it is often best to thin out infected trees even though they are prunable. Make decisions based on tree vigor, spacing, and expected response of residual trees.

9. Buffer zones, defined as areas free of susceptible hosts, are essential to prevent mistletoe from re-entering the control area. Examples include meadows, roads, rivers, clearings and plantations of non-host trees. Construction of new roads, structures or campsites can also be used to create buffer zones.

10. Green pine slash generated by pruning or tree removal should be treated to reduce the risk of pine engraver (Ips spp.) buildup. Slash created in the spring or early summer should be lopped and scattered, piled and burned while green, chipped, or removed from the site.

11. Treat all freshly cut stump surfaces with borax to prevent the establishment of Fomes annosus root disease.

12. Definitely plan to re-enter and treat the campgrounds in 3 to 5 years to remove previously undetected latent infections. Dwarf mistletoe can seldom be eliminated with one entry.

13. A post-suppression evaluation is essential to monitor project effectiveness and thoroughness. This evaluation should be designed before ground work is begun and completed soon after treatment is finished. Completing the Dwarf Mistletoe Survey Data Sheet can help document treatment effectiveness.

DISCUSSION - TRUE MISTLETOE

This is currently the most prevalent pest in the campground. Oaks with evidence of mistletoe, dieback, and heartrot are obviously under stress. The slow decline in the vigor of these trees would be accelerated during periods of drought. Removing the mistletoe stress is possible and would benefit the oaks and also prevent the intensification of infections within and between crowns. Below is a discussion of possible treatment for true mistletoe.

I. ELIMINATE INFECTION

Remove all mistletoe from hardwoods within the campground and from an area large enough to reduce the threat of reintroduction of the parasite from nearby infested trees. Because of long-range spread by birds, it is not possible to eradicate the mistletoe once and for all. However, since true mistletoe often takes five to ten years to develop to damaging proportions, re-treatment will not be necessary for several years. Temporary elimination of the mistletoe can be accomplished as follows:

A. Prune. Where possible, prune infected limbs one foot or more below the point of mistletoe attachment, preferably at the bole or at the nearest crotch. Re-treatment in 2 to 3 years is necessary to remove new plants that sprouted from latent infections.

B. Wrap Infected Branches. Cut off the true mistletoe plant flush with the limb or bole. Wrap the limb at the severed point with a band of black plastic and secure to the limb with twine or flexible tape. Since the mistletoe will not survive without light, it may die within a year or two. This method is time-consuming and not always effective. Shoot production is often only temporarily prevented, the limb may be heat-damaged, and callus tissue may form under the wrappings. Also, the wrapping may provide a refuge for insects or decay fungi that further damage the host.

C. Treat Chemically. A mixture of 2,4-D and dicamba is available as a foam herbicide (Super D Weedone Foam Weed Control), and is, to our knowledge, the only product currently registered for true mistletoe control. Prune the mistletoe shoot to a 1.5-3.0 inch stub and cover it with the herbicide. If the mistletoe plants

are less than three inches in height, apply the foam to the entire plant. Do not apply the herbicide to host limbs smaller than one inch in diameter, and be careful to apply only enough to cover the mistletoe tissue.

Although this method has been shown to be effective, re-treatment may be necessary if the mistletoe resprouts or new infections occur; control must be repeated at least every two or three years to eliminate all latent or new infections. There are other drawbacks. The herbicide must be applied after leaf drop and before leaf buds develop in the spring; otherwise, damage may occur to the host tree or to nearby non-target trees. As a consequence, the treatment is not advisable for live oaks or in locations where live oaks or other evergreen species may be affected by the herbicide dripping from above.

(All pesticide uses for insect and disease projects must receive prior approval, based on a Pesticide Use Proposal (FS-2100-2) submitted with an environmental assessment to the Regional Forester.)

D. Remove Trees. Cut host trees in and around the campground that are severely infected and cannot be pruned. Small- to moderate-size oaks may be cut as close to the ground as possible and allowed to sprout. The sprouts should then be managed.

II. REDUCE MISTLETOE INTENSITY

If the value of the hardwood cover dictates that few or no trees should be cut, you may choose to remove only the most severely infested and most hazardous trees, and treat the remainder to reduce the effect of the parasite without eliminating it. The goal of this alternative is to prolong the lives of individual trees by preventing severe buildup of the parasite. A combination of any or all of the alternatives mentioned above - including whole tree removal, pruning, branch wrapping, and chemical treatment - may be applied.

Another alternative for reducing mistletoe intensity is to remove mistletoe shoots. Break off the exposed mistletoe shoots every two or three years to reduce the stress due to the parasite, and to inhibit local spread by preventing seed production. This is a time-consuming and labor intensive technique, and, since the root-like system of the parasite within the host is unaffected by this procedure, it must be continued indefinitely.

By not attempting to eliminate the mistletoe, the manager agrees to live with the parasite and to accept some growth loss and reduction in vigor. Inspections should be made every 3 to 5 years to determine mistletoe spread and intensification, and to plan for possible re-treatment.

III. PLANT AND FAVOR NON-HOST HARDWOODS

Planting or favoring resistant vegetation is an effective approach to control and will add diversity to the campground. Of the species recommended in the silvicultural prescription to be planted for screening, only interior live oak (Q. wislizenii) is susceptible to this true mistletoe.

FOREST PEST MANAGEMENT SUPPRESSION FUNDS

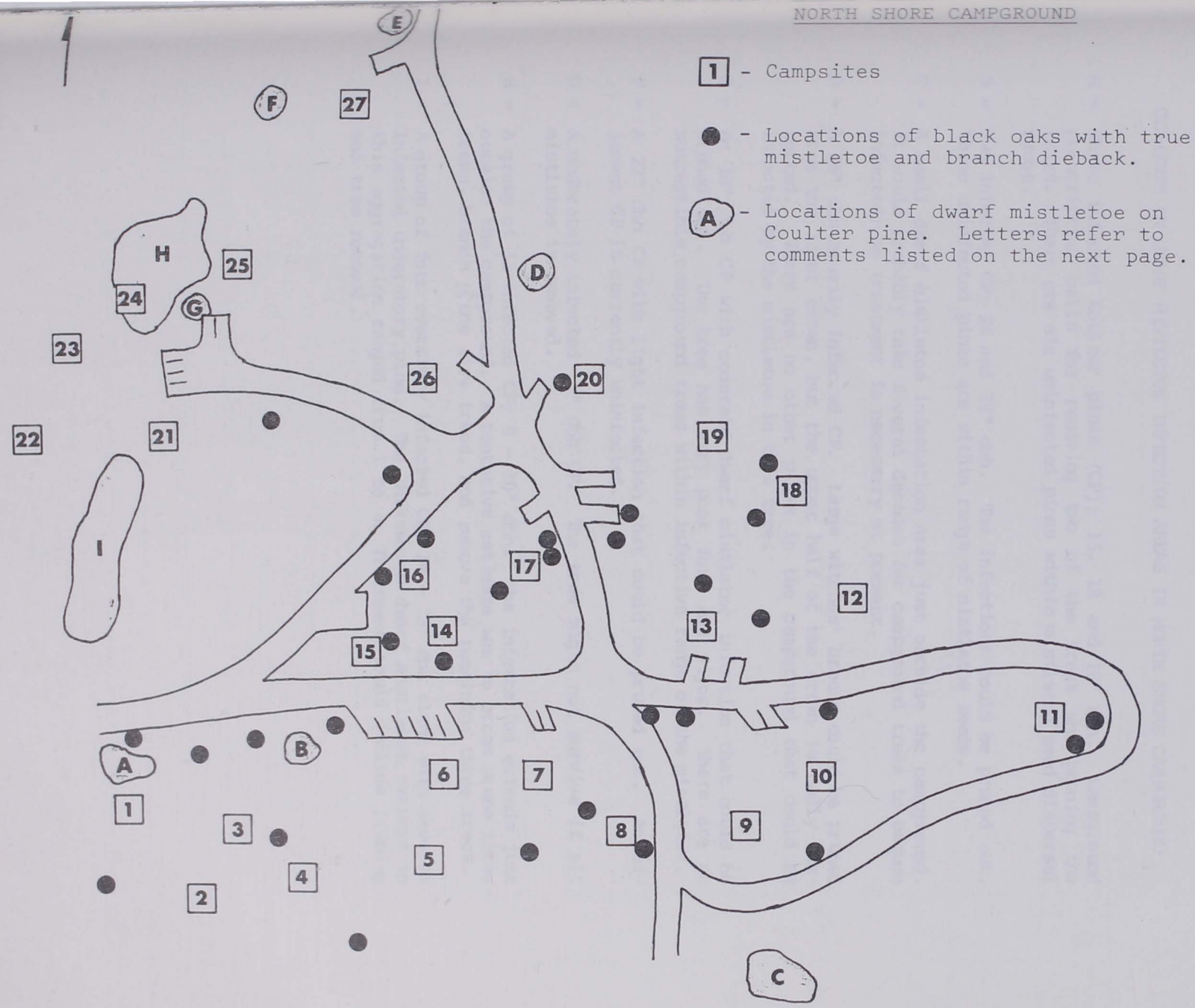
FPM expects to have dwarf mistletoe control funds for FY 1982. If the District decides to request suppression dollars, the following must be submitted to FPM for approval:

- a project proposal, Form FS-3400-2;

- an environmental assessment that includes project objectives, a copy of this evaluation, a project work plan, a benefit-cost analysis and a post-suppression evaluation plan.

At your request, the FPM Staff is available to provide whatever assistance or additional information they can for meeting these requirements. We suggest that prior to beginning any preparation of a project proposal, our staff should meet with Forest/District personnel to go over actual dwarf mistletoe field situations and appropriate treatment strategies. In addition, plans for a post-suppression evaluation and approaches to an economic analysis can be discussed.

NORTH SHORE CAMPGROUND



COMMENTS ON DWARF MISTLETOE INFECTION AREAS IN NORTH SHORE CAMPGROUND

A = Three infected Coulter pines (CP); 15, 18 and 18" dbh. Campground prescription calls for removing two of the trees and pruning the third. There are six uninfected pines within mistletoe seed dispersal range.

B = Two infected CP; 24 and 28" dbh. The infections could be pruned out. Three uninfected pines are within range of mistletoe seeds.

C = A small dwarf mistletoe infestation area just outside the campground. It would probably take several decades for campground trees to become infected; no treatment is necessary at present.

D = A 36" dbh heavily infected CP. Large witches' brooms could be pruned from the lower crown, but the upper half of the crown is badly distorted. There are no other pines in the campground that could be infected by the mistletoe in this tree.

E = An 18" dbh CP with moderate dwarf mistletoe infection that could be pruned out. The tree has very poor form and vigor. There are no susceptible campground trees within infective range of the mistletoe.

F = A 22" dbh CP with light infection that could be pruned out. An adjacent CP is currently uninfected.

G = A moderately infected 17" dbh CP. The tree might not survive if all mistletoe is removed.

H = A group of 11 infected CP; 9 - 30" dbh. The infestation extends just outside the campground. A tentative estimate was to broom prune three trees, branch prune five trees, and remove the remaining three trees.

I = A group of four overstory infected CP; 14 - 23" dbh along with several infected understory pine. The Hawksworth dwarf mistletoe ratings in this aggregation ranged from 1 to 4. Treatment would include pruning and tree removal.

DWARF MISTLETOE SURVEY DATA SHEET

Crew: A _____ Date: A _____

Name of Unit/Area _____

B _____ B. _____

		A. PRE-SUPPRESSION				B. POST-SUPPRESSION			
DBH	Species	% Live Crown	Hawksworth Rating[1]	Est. % Live Crown after Pruning	Action[2]	Hawksworth Rating[1]	% Live Crown	Photo Poin	
								Bear.	Dis

ter rating for each one-third of crown from bottom to top, plus total score, e.g. 2+1+0 = 3

ter code for the following actions: L = Leave tree (no action)
R = Remove tree
P = Branch prune
B = Broom prune